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AiRO: Reverse osmosis on surface water without extensive pretreatment

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Without pretreatment of surface water, excessive membrane fouling can be expected of spiral wound reverse osmosis membranes and fouling management is difficult.

In the AiRO project, the use of air/water cleaning is studied as a hydraulic cleaning method for particulate fouling in RO systems. Ultimately, we aim to omit traditional pre treatment for RO in surface water treatment by using the AiRO concept. In this work we describe our initial experiments with a twin 8" AiRO pilot setup, fed direct with river water.

The results with the direct treatment of surface water with the AiRO concept at 8" scale will be presented in London. The pilot is started up in December 2010 and will have a run time of 17 months in July 2012.

We expect to conclude in London that the results of the experiments showed that air/water cleaning could help control membrane fouling in RO modules.

Introduction

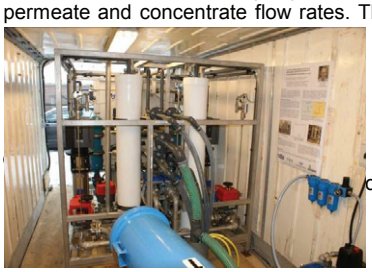
Reverse osmosis is a commonly used treatment step to produce drinking water from surface water. Reverse osmosis membranes can produce water of excellent quality as they remove microbial, ionic and chemical contaminations from the feed water. Unfortunately, energy requirement for RO can be high and extensive pretreatment of the feed water is generally necessary. Without pretreatment, excessive membrane fouling can be expected of spiral wound reverse osmosis membranes and fouling management is difficult.

Air/water cleaning in vertically positioned RO modules has been proposed to remove biofouling from RO membranes (Cornelissen, 2007). In the AiRO project, we study the use of air/cleaning as a hydraulic cleaning method for particulate fouling in RO systems. Ultimately, we aim to omit traditional pretreatment for RO in surface water treatment by using the AiRO concept. In this work we describe our initial experiments with a 8" AiRO pilot setup.

Methods

The AiRO skid consists of 2 identical, fully automatized pilots. The low pressure pump abstracts the feed water from the Hollandse IJssel, a small river in the centre of the Netherlands. The feed water is pre screened using, a 120 µm drum filter TwinOmatic type Hydr. 5780-4. In the whole process line are no cartridge filters installed.

A high pressure pump supplies the feed water to the 2 vertically parallel positioned 8" RO modules (Trisep 8040-ACM5-TSAN). The flow direction of the feed water is top to bottom. Feed flow rate is set at 3.0 m^3/h per pressure vessel and the recovery was set at 15% by controlling permeate and concentrate flow rates. The module is operated at a constant flux of 25 L/m^2/h.



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Flow rates, conductivity of feed and permeates, feed and permeate pressures, as well as the pressure drop over the length of the module are recorded at 1 minute intervals. A compressor, equipped with a water, dust and oil filter, is used to supply air to the back wash water during cleaning. The max air capacity is 250 Nm^3/h. The flow direction during cleaning is changed to bottom to top and the flow rate of the water is 7,0 m^3/h.

The initial cleaning interval of 1 element was 12 hours and from the other element 24 hours.

Results

The results with the direct treatment of surface water with the AiRO concept at 8" scale will be presented in London. The pilot at Vitens research location Montfoort is started up in December 2010 and will have a run time of 17 months in July 2012.

We expect promising results based on preliminary experiments performed in 2009 and 2010 at 4" scale on surface water (Jong, 2010) and at 8" scale on storage basin water (Cornelissen, 2011).

The first half year of the research period (summer of 2011) was used to obtain a stable operation mode, even at a feed water temperature of 25 C and a feed water turbidity of 20 NTU. The back wash interval was reduced from 12/24 hours to 4 hours and the backwash time was increased to 3 minutes. Figure 1 and 2 shows the MTC and pressure drop during the last 6 months of the research. An air-water backwash every 4 hours lasting 1.5 minute and a monthly CIP it seems to be possible to proceed a stable operation.

Results of the endurance test and of detail tests about the performance of the AiRO pilot are the content of the presentation we intend to present in London. This will be a continuation of the first presentation of this topic in Aachen (Jong., 2011).

Conclusions

We expect to conclude that the results of the experiments showed that air/water cleaning could help control membrane fouling in RO modules. The combination of air/water cleaning can potentially reduce the pre treatment of an RO and can reduce the frequency of chemical cleaning steps, saving the use of the chemicals and avoiding long down-time as a result of soaking and rinsing.

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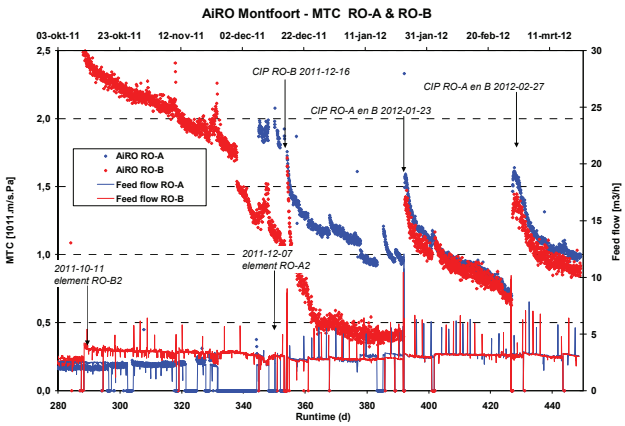

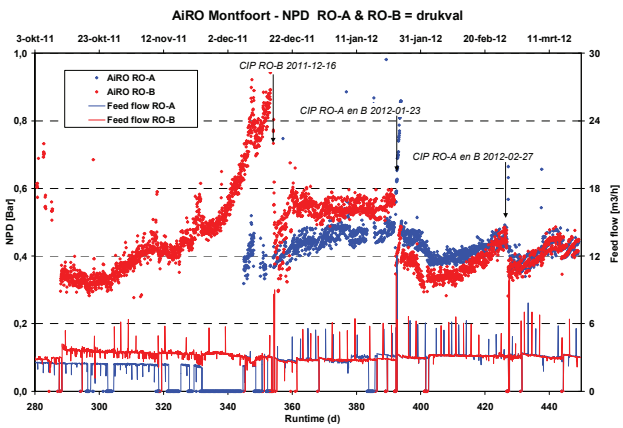

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